

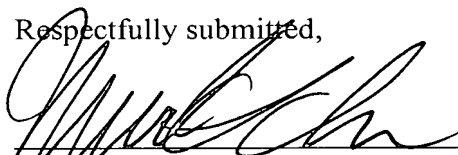
REMARKS

Applicant respectfully requests that the above-identified application be amended to delete claims 1-6 and insert new claims 7-18. A new abstract on a separate page is provided to replace the one originally filed. Additionally, Applicant submits herewith a clean version of a substitute specification and a marked-up version of the specification as filed. This substitute specification includes no new matter.

If the Examiner has any questions regarding this application, Applicant's attorney may be reached at (248) 647-6000.

Attached hereto is a marked-up version of the changes made to the abstract, specification and claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made."

Respectfully submitted,



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Enclosures

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE ABSTRACT:

The abstract previously filed has been replaced with a new abstract submitted herewith.

IN THE SPECIFICATION:

The specification has been replaced with the substitute specification submitted herewith. A marked-up specification is also submitted herewith.

IN THE CLAIMS:

Claims 1-6 have been canceled.

New claims 7-18 have been added.

**TUBULAR COUPLING ELEMENT FOR PRODUCING
A GLUED JOINT WITH A FLUID LINE**

Background of the Invention

Field of the Invention

5 The invention pertains to a tubular coupling element for producing a glued joint with a fluid line. The coupling element includes an inner tube that can be inserted into a fluid line and an outer tube that is concentric to the inner tube and integrally formed on the rear end of the inner tube with a closed ring.

Reference to Related Art

10 A coupling element is known from DE 26 03 299 A1. In that case, an annular gap between an inner tube and an outer tube is filled with a liquid adhesive so that the respective intermediate spaces between the fluid line and the inner tube and the outer tube are entirely filled out after the fluid line is inserted. The adhesive has two liquid components that are held in the annular gap by
15 removable cover films. The utilization of liquid adhesive components has the disadvantage in that the films initially need to be removed at the construction site before the tubular end of the fluid line can be inserted into the annular gap. In addition, the tubular end of the fluid line and the coupling element need to be held in an axially aligned position until the adhesive has hardened. One also needs to
20 proceed very carefully when filling in the annular gap with the adhesive components by correctly metering the components and by sealing the annular gap in an air-tight fashion.

 A tubular coupling element is also known from DE 44 42 407 C1. In that case, an annular gap is filled with a hardenable sealing or binding agent and then
25 closed with a removable air-tight cover. However, this method also results in the aforementioned disadvantages in that the cover film initially needs to be removed

at the construction site before the tubular end of the fluid line can be inserted into the annular gap to produce the glued joint.

Summary of the Invention

The present invention is directed to the filling of an annular gap with a suitable adhesive in such a way that a coupling element can be rapidly and easily connected to the end section of a fluid line.

The objective is attained by filling an annular gap between an inner tube and an outer tube with a dry hot-melt adhesive that is compacted into the shape of a solid ring.

A glued joint between the end of a fluid line and the coupling element can be produced in a much simpler and less expensive fashion than with the state of the art. Since the hot-melt adhesive is introduced into the gap in the form of a solid compacted ring, it can be retained therein without cover elements and reactivated for use at any time by applying heat. A method according to the invention makes it possible to easily connect fluid lines and coupling elements to one another. The method is particularly advantageous when the coupling element is constructed of a plastic material and the fluid line is constructed of an aluminum tube or a metal tube that is encased with plastic as is increasingly utilized in modern technology.

The invention also teaches various advantageous additional developments that serve for achieving the individual advantages described below.

Specifically, the design of the inner tube serves for producing a centered contact with the end section of the fluid line while the hot-melt adhesive is able to distribute between longitudinal ribs.

The design of the outer tube makes it possible for the adhesive inserted between the inner tube and the outer tube to flow outward along the ribs when it is subjected to heat such that a uniform distribution of the adhesive is ensured.

Finally, a method for producing a glued joint advantageously describes
5 how the ring of adhesive introduced into the annular gap can be rapidly heated while the fluid line is inserted, and how the end of the fluid line can be properly pressed into the melting adhesive.

Brief Description of the Drawings

One preferred embodiment of the invention is illustrated in the figures and
10 described in greater detail below, wherein:

FIG. 1 is a side view of a coupling housing with a partial section through a coupling element along the line I-I in FIG. 2;

FIG. 2 is a lateral section view through the coupling element along the line II-II in FIG. 1;

15 FIG. 3 is a longitudinal section view through a compacted adhesive ring to be inserted into an annular gap of the coupling element;

FIG. 4 is a schematic presentation of a coupling housing with an inserted adhesive ring;

FIGS. 5 and 6 are side views demonstrating a sequence of producing a
20 glued joint between the coupling element and the fluid line; and

FIG. 7 shows a side view of a finished glued joint between the fluid line and the coupling element.

Detailed Description

Referring now to FIGS. 1 and 2, there is shown a tubular coupling element
25 1 that is integrally connected to a coupling housing 2. As indicated in FIG. 7, the

coupling element 1 serves for producing a glued joint with a fluid line 3 that, for example, includes an aluminum tube or another suitable metal tube. The coupling element 1 may, however, also be integrally formed on a plug-in element (that is not illustrated in the figures) and conventionally inserted into the coupling
5 housing 2 in order to produce a separable plug-type connection.

Still referring to FIGS. 1 and 2, the coupling element 1 includes an inner tube 4 that is inserted into a free end 20 of the fluid line 3 and an outer tube 5 that is concentric to the inner tube 4 and connected to the rear end of the inner tube 4 by a connecting wall 6. An outer surface 7 of the inner tube 4 preferably includes
10 at least three longitudinal ribs 8 that serve for producing a centered contact with the inner wall 9 of the fluid line 3 when it is pushed over the inner tube 4 (FIG. 6).

As seen in FIG. 2, the outer tube 5 is provided with a series of axially parallel grooves 10 having peaks 11 that are distributed over the inner surface of the outer tube 5. The inside diameter of the inner surface between opposing peaks
15 11 is slightly larger than the outside diameter D of the fluid line 3. The length of the outer tube 5 preferably corresponds approximately to the outside diameter D of the fluid line 3 such that the inner tube 4 is longer than the outer tube 5 by approximately one-half.

Referring now to FIGS 1-3, to produce a glued joint between the tubular
20 coupling element 1 and the fluid line 3, an annular gap 13 between the inner tube 4 and the outer tube 5 is filled with a hot-melt adhesive to approximately half its depth. The hot-melt adhesive is introduced into the annular gap 13 in the form of a compacted solid ring 14 (FIG. 3). The outside diameter $D1$ of the ring 14 is slightly smaller than the inside diameter $d2$ of the peaks 11, and the inside
25 diameter $d1$ of the ring 14 corresponds approximately to an inside diameter d of



the fluid line 3. The width B of the ring 14 has such dimensions that the ring 14 fills out approximately half the depth of the annular gap 13.

Referring now to FIGS. 3 and 4, upon inserting the ring 14 into the annular gap 13 in the direction of the arrow P, the ring 14 is pressed into the gap 13 until it
5 contacts the connecting wall 6 (FIG. 4). The ring 14 is preferably pressed into the gap 13 with the aid of an auxiliary tool 15 that contains circumferentially distributed pressing elements 16. Following insertion of the ring 14, the coupling element 1 is ready for gluing to the free end 20 of the fluid line 3.

As shown in FIGS. 5–7, the coupling housing 2 is initially held in position
10 with a coupling holder 17 while the fluid line 3 is moved into a position opposite the coupling housing 2 axis through the use of a tube holder 18. An induction coil 19 is then placed around the free end 20 of the fluid line 3 such that the tubular end 20 of the fluid line is preheated (FIG. 5).

The coupling element 1 is pressed on the free end 20 of the fluid line 3 in
15 the direction of the arrow M by means of the holder 17 and is surrounded by the induction coil 19. The adhesive ring 14 melts due to the thermal effect generated by the induction coil. While the tubular end 20 of the fluid line 3 penetrates into the hot-melt adhesive, the adhesive is displaced on the inner wall 9 and the outer wall 12 along the ribs 8 and the grooves 10 in the inserting direction M. This
20 causes the intermediate spaces between the tubular end 20 of the fluid line and the coupling element 1 to be completely filled out with the hot-melt adhesive (FIG. 6).

After the hot-melt adhesive has set and pre-hardened, the process of connecting the coupling element 1 and the fluid line 3 is concluded such that the
25 holders 17 and 18 can be removed and the adhesive permitted to cure (FIG. 7).



The coupling 2 with the fluid line 3 glued thereto can then be transported to the site of its intended use.

In the embodiment shown, the tube holder 18 is shown as a solid body with a blind hole into which the fluid line 3 is inserted with its outgoing end.

5 However, the tube holder may also include a clamping element that surrounds the fluid line 3, e.g., a pipe clamp. This is particularly advantageous if the fluid line 3 has a greater length than shown in FIGS. 5 and 6.

I claim:

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Abstract

A tubular coupling element for producing a glued joint with a fluid line and a method for producing such a glued joint. The coupling element includes an inner tube that is insertable into a fluid line and an outer tube that is constructed concentric to the inner tube and integrally connected to the rear end of the inner tube by a connecting wall. An annular gap is present between the two tubes and is designed to receive an end section of the fluid line and a hot-melt type adhesive in a compacted solid form shaped as a ring. A connection between the coupling element and the fluid lines can be easily established by first introducing the adhesive in the annular gap and then melting it by rapidly supplying heat while the end section of the fluid line is pressed into the annular gap of the coupling element.